GIA Environmental Health and Safety Indoor Air Quality Management Guideline

DOCUMENT IDENTIFIER: A-SP-ELMF773-00-0000 Rev A, 22-May-1992

ABSTRACT: The purpose of this GIA guideline is to define the basic elements and responsibilities of an Indoor Air Quality Program for the office environment.

APPLICABILITY: This GIA guideline shall apply to GIA facilities and operations worldwide unless superseded by more stringent country and/or local regulations.

STATUS: APPROVED 22-May-1992; use VTX SMC for current status.

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1 INTRODUCTION

The purpose of this GIA guideline is to assist in the establishment and maintenance of an Indoor Air Quality Program for the office environment. Certain components of this guideline may have wider application in the industrial environment.

1.1 SCOPE

This guideline shall apply to GIA facilities and operations worldwide unless superseded by more stringent country and/or local regulations.

1.2 Guideline

Each site shall:

- Provide employees and visitors with an environment with air quality that is safe and healthful

- Have a process in place to effectively address complaints concerning indoor air quality

1.3 RESPONSIBILITIES

- Site Manager

  Ensure that an effective program exists and appropriate resources are assigned so that acceptable indoor air quality is maintained.

- Facilities or Property Organization

  Before agreeing to occupy a newly constructed or leased building, ensure that the building and the systems therein meet country and local codes and *Design and Development of the Work Environment, EF-A0931-50*. Refer also to *Guideline on the Maintenance of Indoor Air Quality, EL-CP750-00*.

  The definition of minimum indoor air quality requirements shall be included as part of the lease specifications, where possible.

  For sites that are already occupied, implement a program that ensures indoor air quality meets minimum acceptable requirements, and ensure that all indoor air quality issues and complaints receive an appropriate and timely response.

  Refer to Digital Property Development Performance Guidelines: Design and Development of the Work Environment and to Digital Guideline on the Maintenance of Indoor Air Quality.

- Site Environmental Health and Safety (EH&S)

  Provide assistance to ensure that buildings occupied by Digital operate within acceptable indoor air quality parameters.

  Assist in the investigation and resolution of indoor air quality issues and complaints.

- Health Services (or the group having this responsibility)

  Notify EH&S and the Facility or Property Organization if there are reports or medical complaints that may potentially be attributed to the lack of maintenance of acceptable quality of indoor air.

  Assist in the investigation and resolution of indoor air quality issues and complaints.

- Additional Assistance

  Area EH&S, Corporate Environmental Health and Safety, Corporate Design and Facilities, and Corporate and Area Health Services are available to provide additional information and support.

1.4 LANGUAGE REQUIREMENT FOR THIS GUIDELINE

The details of this GIA guideline and all documentation associated with it, such as manuals, training materials, signs, labels, postings, and so forth, must be available in English and the accepted and official local language.

1.5 DEFINITIONS

- **Acceptable Indoor Air Quality**—Air in which contaminants have not been found to be present at harmful concentrations, and with which a substantial majority of the people (usually 80% or more) exposed do not express dissatisfaction.

- **HVAC**—Heating, Ventilation, and Air Conditioning.

- **IAQ**—Indoor Air Quality.

2 IAQ PROGRAM REQUIREMENTS

The goal of this guideline is to assist in the establishment and maintenance of acceptable IAQ.

The following system conditions and contaminant control levels are thought, as a minimum, to be required to achieve and maintain acceptable IAQ in the general office environment. It may be possible that if the conditions and contaminant control levels are not attained that there may be, by definition, acceptable indoor air quality. It may also be possible that these parameters might be attained and there might still not be, by definition, acceptable indoor air quality.

Applicable country or local codes and standards, where more stringent, shall take precedence.

Misapplication of energy conservation measures and some energy efficient building designs may cause conditions that lead to inadequate IAQ. The application of energy conservation measures must be balanced with the needs of building occupants to ensure both sets of needs are optimized.

2.1 HVAC SYSTEM CONDITIONS

- Design

  New installations and modifications to existing HVAC systems shall take into account nearby cooling towers, adjacent buildings, and other potential sources of contamination.

  When installing outside air intakes or exhausts, note the proximity of existing intake and exhaust devices. They shall be located as far apart as possible and be properly designed to reduce the potential for contaminant re-entrainment from building processes, sanitary exhausts, and power or boiler room exhausts, and so forth.

  Exhaust stacks shall be above the air inlets and be of the vertical discharge type, not the mushroom cap type.

- Humidification

  The use of humidifiers shall be limited to process or manufacturing areas unless there is an exception, such as the need to address particular regional climatic conditions, that may require general area humidification.

  If not properly operated and maintained, humidifiers can create conditions conducive to the growth of microorganisms and allergens. The routine use of biocides or descaling agents in the airstream should not be permitted.

  The installation of humidifiers in acoustically lined air conditioning ductwork is of special concern.

  Do not use moisture absorbing insulation material inside air conditioning ductwork.

  Repair all damaged lining material to avoid further degradation, accumulation of dirt, and growth of microorganisms and allergens.

  Areas requiring humidification should be carefully designed and the equipment should be kept clean and well maintained. Self contained steam generating humidifiers are recommended over evaporative or infrared humidifiers.

  Regardless of the application, proper equipment maintenance and cleanliness is essential.

- Operation

  Burn in of newly fit up or completed buildings— Run the HVAC system at operating temperatures prior to occupancy to purge the odors associated with new paint, carpet, furniture, and other new finishes and furnishings.

  Morning warm up and cool down cycles—As part of energy conservation measures during start up, outside air dampers are kept closed until the building is at temperature. The temperature control then opens the dampers to add outside air and also purge the building of occupant generated contaminants remaining from the previous day.

  The timing of the morning warm up or cool down shall also be scheduled to ensure that occupant generated contaminants have been purged from the building and there is not the perception of stuffiness by building occupants.

Complete purging can be confirmed by measuring and finding the carbon dioxide levels roughly equal inside and outside the building. If not, the initialization of the warm up or cool down cycle should be done earlier until the desired effect is obtained.

- Maintenance and Inspection

  Program Elements—Proper maintenance and operation of the HVAC systems is essential. The carbon dioxide concentration, temperature, and relative humidity of indoor air should be monitored by Facility or Property Management, at least quarterly, as part of a regular documented HVAC inspection and maintenance program. At a minimum, the program shall also include the following:

  Inspection of variable air volume devices (VAVs) to ensure operation according to specification

  Releveling or modifying drip pans to eliminate standing or stagnant water. Do not routinely use biocides or descaling agents in the airstream.

  Cleaning coils, drip pans, traps, and other wetted areas before and after the cooling season, or at least semiannually

  Reviewing the capacity of the air-conditioning system and the amount of electronic equipment in high use areas to ensure that sufficient air conditioning exists to deal with the resulting heat load when temperature extremes are experienced

  Checking building air inlets and exhausts for potential re-entrainment of contaminants into the HVAC system

  Inspecting the entire system from the point where the air enters the building to the point where it is exhausted, both on the outside and inside of equipment, for the accumulation of dust, dirt, and other debris.

  Ensuring that air handling unit filter racking systems are tight and the filters are clean and secure.

  Building Operation—Ensure that operations such as painting, carpet and tile installation, and activities that could potentially generate hazardous vapors or annoying odors are conducted at times when the building is not occupied, when occupancy is low, or when precautions have been taken to minimize disruption.

  The inside use of internal combustion engines, such as powered industrial vehicles, generators, and so forth shall only be permitted with the prior approval of EH&S.

  Ensure that industrial processes do not generate excessive levels of contaminants into the workplace.

  Personal Protection—Employees performing maintenance work on HVAC systems must be protected from chemical and biological hazards.

  Personal exposure may result from being downwind of an exhaust stack, from dust generated during filter changes, or from other maintenance activities.

There shall be required training in hazard awareness, the use of ventilation, personal protective equipment (protective clothing, gloves, safety glasses, face shields, and respirators) during maintenance activities.

2.2 PHYSICAL PARAMETERS AND CONDITIONS

The following list of parameters and conditions is usually used to define acceptable indoor air quality.

Outside air	20 cfm/person For buildings where smoking is permitted. This does not include designated smoking areas. 15 cfm/person For buildings where smoking is not permitted.
Temperature	Winter: 20°C (68°F) minimum Summer: 25.6°C (78°F) maximum
Air movement	20 ft to 50 ft/min in the work area, at desk level
Air filtration efficiency	>50% efficient (new buildings) To increase the filter efficiency on existing buildings, air handling equipment must be evaluated for the ability to handle any required retrofit and any additional system resistance.

2.3 CHEMICAL CONTAMINANT LEVELS

Contaminants from inside the building that may affect building occupants can result from improperly maintained copy machines, tobacco smoke, pesticides, boiler additives, cleaning agents, combustion sources, and inadequate process exhaust. Contaminants from the building fabric that may affect building occupants can result from the outgassing of particle board, carpet glues and adhesives, and caulking as well as the deterioration of fiberglass-lined duct work.

Building materials and furnishings should be selected with characteristics that minimize the generation of potentially hazardous materials into the work environment.

Contaminants from outside the building, that may affect building occupants, can be the result of the entrainment of motor vehicle exhaust, boiler gases, process exhaust, or construction and roofing.

The following list of chemical contaminant levels is usually used to define acceptable indoor air quality.

Carbon dioxide	700 ppm This level is an indicator of the efficiency of the ventilation system and the adequacy of outside air introduction. Expect IAQ complaints to occur in the range of 700 ppm to 1000 ppm.
Formaldehyde	Less than 0.1 ppm
Carbon monoxide	Less than 10 ppm
	Levels of other potential contaminants:
Nonindustrial office environments for contaminant and odor control	Less than 0.1 $\times$ applicable occupational exposure limit

2.4 BIOLOGICAL CONTAMINANT LEVELS

Bioaerosols are routinely present in the environment. The ratio of the indoor level of bioaerosols to the outdoor level is important. Depending on the species involved, an acceptable ratio of indoor to outdoor level (amplification) may be as much as 200 or more to 1.

To minimize the growth of bioaerosols, air handling equipment must be kept dry, clean, and disinfected. Remove severely wetted and contaminated building materials and furnishings, where possible, or disinfect in place if removal is not feasible. Previously water-damaged areas and materials should be routinely examined for the development of mold or other growth.

Bioaerosol monitoring should not be done routinely. It should only be conducted after visible areas of mold or similar growth have been removed and the situation still suggests a bioaerosol may be the causative agent for an ongoing IAQ complaint.

If required, bioaerosol monitoring should only be performed by someone trained in applicable sampling techniques who is capable of properly interpreting the data. The Area EH&S group can help locate such a resource.

2.4.1 Legionnaires' Disease Bacteria (LDB)

Routine culturing for LDB without a well defined outbreak of the disease is not recommended. Culturing and interpretation of results are difficult. The most prudent course of action is to keep the cooling systems as clean as practical. *Coordinate with Area EH&S to ensure that the proper precautions are taken.*

3 IAQ COMPLAINT RESPONSE

The prevention or resolution of issues and complaints related to the quality of indoor air is a cooperative effort that involves Facility and Property Management, EH&S, and Health Services (or the group having this responsibility).

3.1 BACKGROUND

The causes of poor indoor air quality may not be easily identified. Low level contaminants may be concentrated in a relatively enclosed environment. Contaminants may be:

- Gases
- Vapors
- Particles
- Microorganisms

Or any combination of these elements that are continuously introduced into the indoor environment by building occupants, the outgassing of the building materials and furnishings, the use of chemicals, or external sources (outside air makeup or infiltration).

When they are not removed or dissipated through ventilation, contaminants may become concentrated to a level where they become an irritant or even adversely affect human health. Employees may experience eye and respiratory tract irritation, headache, drowsiness, fatigue, nausea, and general malaise even though there is seemingly no apparent cause. A modification to the building environment may result in the disappearance of symptoms without actual identification of the causal agent.

3.2 FACILITY AND PROPERTY MANAGEMENT RESPONSE

Drastic building modifications that involve the HVAC system should not be undertaken until the building systems are reviewed, their operation maximized, and other potential causes for complaints are eliminated.

In response to employee complaints, Facility or Property Management shall ensure that site systems comply to IAQ program requirements as defined in head 2.

3.3 EH&S RESPONSE

Interview employees to identify the cause of the complaints and determine if any operations or work processes are contributing to or generating contaminants. (See Appendix A.)

Review employee complaints and monitor work areas for potential sources of contaminants such as the following:

- Improperly maintained laser printers and copiers that may generate excessive ozone, a known irritant

- Moisture from potted plants that can be source of microorganisms, allergens, and increased humidity

- Signs of water damage (wet ceiling tiles, stained carpets or walls) that can be sources of microbial growth

- New office furnishings such as carpeting, wall partitions, and furniture that can be sources of chemical irritants such as formaldehyde and volatile organic compounds (VOCs)

- Significant use of carbonless forms, correction fluid, cleaning agents, air fresheners, and so forth, are also potential sources of VOCs

Monitor for contaminants from nearby sources such as manufacturing, process and construction areas. These may require additional levels of control such as local exhaust or dilution ventilation.

Observe the location, design, and condition of outdoor air intakes for evidence of, or the potential for, contamination and entrainment from adjacent neighboring buildings, operations, or other activities.

Inspect and test existing local exhaust ventilation to ensure that its design and air flow are adequate for the particular operation as it is currently performed.

3.4 HEALTH SERVICES RESPONSE

Health services response is conducted by health services professionals or the group having this responsibility.

Interview and examine employees in an attempt to resolve building related issues that may exist. (See Appendix A.) Early involvement of the site medical consultant and communication with the employee's personal physician is encouraged.

Consult with Digital Corporate Health Services or Area Health Services, or both, when complaints are widespread, difficult to resolve, or the health effect is more severe than the symptoms already discussed in head 3.1, *Background*.

3.5 ADDITIONAL ASSISTANCE

The Corporate and Area resources listed under head 1.3 can assist by:

- Helping to design studies that evaluate the cause(s) of inadequate indoor air quality and resulting employee health complaints

- Providing methodologies for characterizing indoor air for the possible presence of chemical and biological contaminants

- Sharing the current technologies for maintaining acceptable indoor air quality

- Being a liaison to outside consultants and government agencies

- Supporting and assisting in the hiring of outside consultants

APPENDIX A GENERAL INDOOR AIR QUALITY SURVEY QUESTIONNAIRES

The following are examples of two types of survey questionnaires that can be used to investigate issues potentially involving building-related complaints. They are included as examples and can be modified based on their applicability to the particular building or situation, or both.

INDOOR AIR QUALITY COMPLAINTS—GATHERING ENVIRONMENTAL INFORMATION

INVESTIGATOR: _____

FACILITY: _____

DATE: _____

1. Specific nature of the complaints, odors, headaches, irritation, and so forth

   _____

   _____

   _____

   What locations report the worst or most complaints?

   _____

   _____

   Number of people complaining? _____ Total people in complaint area(s)? _____

   What is the history of the complaints? Was there a triggering incident? Is there any apparent pattern (time of day or week, seasonal, and so forth)?

   _____

   _____

   _____

   How long has the group been in the building? _____

   Is the building new, old, or renovated? _____

   Who manages the building? _____

2. List any activities using chemicals of any type in the areas of concern.

   _____

   _____

   _____

   Any recent inside or outside use of pesticides, paints, sealants, and so forth?

   _____

   _____

   _____

3. Describe the heating, cooling, and ventilation system in these areas. Is there a central heating, ventilation, and air-cooling (HVAC) unit, and if so where is it located?

Describe the type, general location, and dimensions of the local air supply and return air vents.

Are there separate air exhaust units? Are they operable and used?

Does the mechanical ventilation system have an outside air intake? If so, what is the approximate percentage of outside air currently being supplied, and is it adjustable?

If there are modulating controls, what are the settings and percentages?

Can the windows be opened? _____

Heating system type? Gas _____ Oil _____ Electric _____ Other _____

Is the ventilation system regularly maintained? _____ If so, by whom?

_____

When were the filters last changed or cleaned? _____

When was the system last thoroughly checked for proper operation and by whom?

How is the ventilation set and operated? Is the system on a pneumatically controlled computerized system? _____ Is the system on a timer? _____ If manual operation only, is control of the thermostats restricted? _____

What hours is the system completely on, and to what extent is the system shut down overnight and weekends?

What are the normal temperature settings for the different times of the day and week?

When the system is on, are the fans on continuously or on only when there is temperature demand (automatic)?

Humidity control?

None? _____ Built into the ventilation system? _____
Provided by independent units? _____ Other?_____

Perceived or actual relative humidity range?

What are the best guesses as to the cause of the complaints and as to what can be done to improve occupant health and comfort?

INDOOR AIR QUALITY COMPLAINTS—GATHERING MEDICAL INFORMATION

INVESTIGATOR: _____

FACILITY: _____

DATE: _____

1. Are you aware of any issues that may be occurring as a result of environmental factors at work? Yes _____ No _____

   _____

   _____

   _____

2. What are some of the issues you have heard about?

   _____

   _____

   _____

   _____

3. Have you experienced any of these problems or symptoms? Yes _____ No _____
4. What problems or symptoms have you experienced? (Check all appropriate symptoms as first described by the person being interviewed).

   Headache _____ Dizziness _____

   Drowsiness _____ Light-headedness _____

   Sore throat _____ General feeling of illness _____

   Other _____

   _____

5. When did you first notice these problems occurring?

   After moving to your present location? _____

   Before moving to your present location? _____

   For the past _____ days/weeks/months?

   Other _____

   _____

6. Does anything make these problems better?
   Leaving your work area? _____
   Leaving the building? _____
   Other? _____
7. Does anything make these problems worse?
   Fatigue? _____ Stress? _____
   Time of day? _____ If so, what time? _____
   Particular day of the week? _____ What day? _____
   Being in a particular part of the building? _____
   What part of the building? _____
   Being in a particular part of a floor? _____
   What part of the floor? _____
8. Have you ever experienced problems like this before? Yes _____ No _____
   If yes, please explain.

   _____

   _____

   _____
9. What do you think may be causing these problems?

   _____

   _____

   _____
10. Have you sought medical treatment for these problems? Yes _____ No _____
11. Do you intend to seek medical treatment? Yes _____ No _____
12. Have you ever been treated for these problems in the past? Yes _____ No _____

13. Can you describe the environment in which you work?

    Seating arrangement: _____

    Ventilation: OK _____ Stuffy _____ Environmental tobacco smoke _____

    Drafts _____ Other

    _____

    _____

    Temperature: OK _____ Too hot _____ Too cold _____

    Humidity: OK _____ Too hot _____ Too cold _____

    Stressful? Yes _____ No _____ If yes, what do you think may be causing the stress?

    _____

    _____

    _____

14. What do you feel should be done about these problems?

    _____

    _____

    _____

15. Do you smoke cigarettes or cigars? Yes _____ No _____
16. Do you eat at your desk? Yes _____ No _____
17. Is there anything else you would like to say about these problems?

    _____

    _____

    _____

APPENDIX B REFERENCED DOCUMENTS

B.1 Other Digital Documents

Document Number	Document Title
EF-A0931-50	*Design and Development of the Work Environment*
EL-CP750-00	*Guideline on the Maintenance of Indoor Air Quality*

B.2 Ordering Information

Following are the sources for documents not available from Standards and Methods Control.

- Manager of Corporate Design and Facilities
  MSO2-3/G19

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